ELECTRICAL SWITCHING APPARATUS INTERFACE ASSEMBLY AND OPERATING HANDLE ATTACHMENT THEREFOR

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to electrical switching apparatus and, more particularly, to an electrical switching apparatus including an operating handle and an interface assembly for activating the operating handle from a remote location. The invention also relates to operating handle attachments for electrical switching apparatus interface assemblies.

Background Information

Electrical switching apparatus include, for example, circuit switching devices and circuit interrupters, such as circuit breakers, contactors, motor starters, motor controllers and other load controllers.

Circuit breakers are generally old and well known in the art. An example of a circuit breaker is disclosed in U.S. Patent No. 5,341,191. Circuit breakers are used to protect electrical circuitry from damage due to an overcurrent condition, such as an overload condition or a relatively high level short circuit or fault condition. Molded case circuit breakers, for example, include at least one pair of separable contacts which are operated either manually by way of a handle disposed on the outside of the case or automatically by way of an internal trip unit in response to an overcurrent condition.

Circuit breakers typically have two or three possible operating handle positions, corresponding to the status of the separable contacts. For example, these positions may include an ON position, in which the separable contacts are closed, an OFF position in which the contacts are open, and a tripped position in which the contacts are tripped open. Typically, the handle position corresponding to the tripped position of the contacts is in between the ON and OFF positions.

In certain applications, it is often desired or required to actuate the operating handle of the circuit breaker from a remote location. For example, circuit breakers are often mounted within the interior of a metal cabinet, such as a switchboard or panel board as part of an industrial power distribution system. See, *e.g.*, U.S. Patent No. 4,945,450. In motor control centers, the circuit breaker is

typically contained within a cabinet, which is locked, in order to prevent access when the circuit breaker is ON and the electrical equipment within the cabinet is energized. When a circuit breaker is mounted in a remote location, for example, within the interior of a switchboard, a locked electrical cabinet or any other remote location, an externally accessible switching apparatus, such as an actuating handle, is employed to interface with the circuit breaker and actuate the breaker operating handle.

A relatively simple way to move the breaker handle from such remote locations is through use of a mechanical interface or linking assembly connecting the circuit breaker operating handle to the externally accessible actuating handle. In this manner, the circuit breaker can be actuated, for example, without having to open the cabinet. In such interfacing assemblies, effective operation relies heavily upon the secure engagement of the circuit breaker operating handle and a dependable linkage between the operating handle and the external actuating handle. For example, a linkage of insufficient strength or rigidity may not be capable of overcoming the resistive forces associated with moving the circuit breaker operating handle. Inadvertent separation of the circuit breaker operating handle from the interfacing linkage would require disassembly of the electrical cabinet to access the breaker and reattach the connection.

Interfacing assemblies employ a variety of circuit breaker operating handle extensions and actuating mechanisms having a wide array of operating handle engaging mechanisms. However, construction of the assemblies is typically complex, often comprising numerous, separate parts and frequently requiring modification to the circuit breaker operating handle and/or housing.

U.S. Patent No. 3,142,744 discloses a switch operating attachment primarily for use by children too small to reach normally placed light switches, such as wall-mounted light switches. The attachment includes a mounting head with a rectangular counter bore for receiving the end of the light switch handle. A U-shaped spring is engaged endwise in the counter bore close to the bottom of the counter bore with the spring legs extending along the counter bore walls. The spring legs serve as spring jaws for gripping the upper and lower surfaces of the switch handle. The jaws are formed with longitudinally spaced gripping teeth or corrugations so that the teeth bite into and hold the switch handle secure within the head. The attachment further

includes an elongated handle, which at one end, connects to a slot in the mounting head and at the other end extends far enough downwardly from the light switch handle to be within the reach of small children.

U.S. Patent No. 4,626,638 discloses a mechanical operating system for operating a molded case circuit breaker from a remote position. The system is comprised of numerous complex components, including a master operating assembly and a slave operator for manipulating the circuit breaker handle. The master operating assembly is fixed at a location away from the circuit breaker and includes a handle connected to a flexible cable. The flexible cable is connected to a slave operator attached to the housing of the circuit breaker and includes an opening for encapturing the circuit breaker handle. Moving the handle of the master operating assembly displaces the slave operator and the circuit breaker handle encaptured therein.

U.S. Patent No. 5,193,666 discloses a handle extender for a molded case circuit breaker including a remote actuator mechanism. The actuator cable is arranged in an endless loop between the actuator handle and the circuit breaker operating handle. Moving the actuator handle moves the circuit breaker operating handle. The remote actuator mechanism has numerous components including the actuator cable which includes an outer sheath and an inner flexible wire connected to the circuit breaker operating handle by a U-shaped plate. A fastener, which passes through the U-shaped plate and the operating handle, secures the flexible wire to the operating handle.

There is a need, therefore, for a simplified electrical switching apparatus interface assembly and operating handle attachment that effectively secures the operating handle for actuation from a remote location, without requiring modification to the electrical switching apparatus handle or housing.

Accordingly, there is room for improvement in electrical switching apparatus interface assemblies and in interface assemblies employing operating handle attachments.

SUMMARY OF THE INVENTION

These needs and others are satisfied by the present invention, which provides an interface assembly with an attachment for the operating handle of an

electrical switching apparatus. The assembly includes the operating handle attachment and a connector linking or interfacing the operating handle to a remotely disposed switching apparatus, such as an actuating handle.

As one aspect of the invention, an operating handle attachment for use with an electrical switching apparatus interface assembly includes an operating handle, an actuator disposed remote from the operating handle, and a connector therebetween. The operating handle attachment comprises: a handle-engaging segment structured to securely engage the operating handle; and an interfacing segment structured to receive the connector, in order to link the operating handle to the actuator.

The handle-engaging segment may include a member adapted to slide over the operating handle and the interfacing segment may include at least one tab disposed on the member and having an opening for receiving the connector.

Another aspect of the invention, an electrical switching apparatus interface assembly comprises: a first electrical switching apparatus including a housing having an opening and an operating handle protruding from the opening; a second switching apparatus disposed remote from the first electrical switching apparatus, in order to permit remote actuation of the operating handle of the first electrical switching apparatus; a connector including a first portion linking the second switching apparatus and a second portion; and an operating handle attachment comprising: a handle-engaging segment securely engaging the operating handle of the first electrical switching apparatus; and an interfacing segment receiving the second portion of the connector, in order to link the operating handle of the first electrical switching apparatus to the second switching apparatus.

As another aspect of the invention, a power distribution system comprises: a switchgear cabinet including an interior and an external panel; a first electrical switching apparatus mounted within the interior of the switchgear cabinet, the first electrical switching apparatus including a housing having an opening and an operating handle protruding from the opening; a second switching apparatus disposed on the external panel of the switchgear cabinet, the second switching apparatus being remote from the first electrical switching apparatus, in order to permit actuation of the operating handle of the first electrical switching apparatus therefrom; a connector

including a first portion linking the second switching apparatus and a second portion; and an operating handle attachment comprising: a handle-engaging segment securely engaging the operating handle of the first electrical switching apparatus; and an interfacing segment receiving the second portion of the connector, in order to link the operating handle of the first electrical switching apparatus to the second switching apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

A full understanding of the invention can be gained from the following description of the preferred embodiments when read in conjunction with the accompanying drawings in which:

Figure 1 is an exploded, isometric view of a circuit breaker interface assembly in accordance with the present invention.

Figure 2 is an isometric view of the operating handle attachment of Figure 1.

Figures 3-7 are isometric views of operating handle attachments for interface assemblies in accordance with other embodiments of the invention.

Figure 8 is an isometric view of the operating handle attachment of Figure 2 engaging the operating handle of a single-pole circuit breaker in accordance with an embodiment of the invention, with the connector shown in phantom-line drawing.

Figure 9 is an isometric view of the operating handle attachment of Figure 5 engaging the operating handle of a single-pole circuit breaker in accordance with an embodiment of the invention, with the operating handle shown in hidden-line drawing.

Figure 10 is an isometric view of the operating handle attachment of Figure 6 engaging the operating handle of a single-pole circuit breaker in accordance with another embodiment of the invention, with the operating handle shown in hidden-line drawing.

Figure 11 is an isometric view of the circuit breaker interface assembly of Figure 1 with a portion of the switchgear cabinet cut-away to show internal structures.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For purposes of illustration, the invention will be described as applied to a circuit breaker, although it will become apparent that it could also be applied to other types of electrical switching apparatus (*e.g.*, without limitation, circuit switching devices and other circuit interrupters such as contactors, motor starters, motor controllers and other load controllers).

As employed herein, the term "switchgear cabinet" refers to the cabinet of a power distribution system such as, for example, a panel board or load center, which is structured to secure electrical switching apparatus, expressly including, but not limited to, circuit breakers.

As employed herein, the term "fastener" refers to any suitable fastening, connecting or tightening mechanism expressly including, but not limited to, screws, bolts and the combination of bolts and nuts.

Figure 1 illustrates a power distribution system 2 employing an electrical switching apparatus interface assembly 10 to remotely actuate a circuit breaker 12. As shown, the basic components of the power distribution system 2 include a switchgear cabinet 4 having an interior 6 and an external panel 8. A first electrical switching apparatus, such as the exemplary circuit breaker 12, is mounted within the interior 6 of the switchgear cabinet 4. The exemplary circuit breaker 12 includes a housing 14 having an opening 16 and an operating handle 18 protruding from the opening 16. A second switching apparatus, such as the exemplary actuating handle 20, is disposed on the external panel 8 of the switchgear cabinet 4, remote from the circuit breaker 12, in order to permit actuation of the operating handle 18 therefrom. A connector 24 including a first portion 26 links or interfaces with a connector tab 22 on the backside of the actuating handle 20. The connector 24 also includes a second portion 28 connected to an operating handle attachment 30. The exemplary connector 24 is a steel rod, however, it will be appreciated that any suitable alternative connector (not shown), made from any suitable material and structured to be rigid or flexible (not shown), may be employed.

Continuing to refer to Figure 1, the operating handle attachment 30 includes a handle-engaging segment 32, structured to securely engage the operating handle 18 of the circuit breaker 12, and an interfacing segment 34, structured to

receive the second portion 28 of the connector 24, in order to link or interface the circuit breaker operating handle 18 with the remotely located actuating handle 20.

The circuit breaker operating handle 18 is operable between a first position and a second position corresponding to "on" and "off" circuit breaker operating modes in which the circuit breaker is, respectively, capable of energizing or not energizing the power distribution system 2. The circuit breaker operating handle 18 is securely engaged within the handle-engaging segment 32 of the operating handle attachment 30 and is linked or connected to the exemplary actuating handle 20 by the connector 24 which has first and second positions corresponding to the first and second, "on" and "off" positions, respectively, of the operating handle 18. This permits remote actuation of the circuit breaker 12 located within the interior 6 of the switchgear cabinet 4 from the remote location on the external panel 8 of the switchgear cabinet 4.

Figures 3-7 show example alternative embodiments of the operating handle attachment 30 of Figures 1 and 2. Each of these operating handle attachments is structured for securely engaging the operating handle 18 of the circuit breaker 12, in order to provide a secure interfacing attachment location for the connector 24 (Figure 1) to facilitate remote actuation of the circuit breaker 12 using, for example, the exemplary actuating handle 20 (Figure 1).

As best shown in Figure 2, the operating handle attachment 30 is a stamped metal member 40 formed to slide over the top of the circuit breaker handle 18 (Figure 1). The stamped metal member 40 includes the handle-engaging segment 32 consisting of a pair of opposing handle-receiving apertures 42, 43. At least one of the handle-receiving apertures 42, 43 includes at least one projection, such as the exemplary plural serrations 44 (one of the opposing handle-receiving apertures 42 is shown with a plurality of serrations 44 (*e.g.*, or teeth) in Figure 2. The exemplary interfacing segment 34 includes at least one tab 36 disposed on the stamped metallic member 40. The tab 36 has an opening 38 for receiving the connector 24 (Figure 1) therein. As shown in Figure 8, the serrations 44 engage the operating handle 18 when it is inserted therethrough, thereby securely engaging such operating handle. The operating handle attachment 30 may optionally include a pair of strengthening ribs 46 to increase the rigidity of the tab 36. The exemplary stamped metallic member 40 is

formed from steel. However, it will be appreciated that the operating handle attachment 30 could be made from any suitable alternative material.

Figure 3 shows another operating handle attachment 30′. The operating handle attachment 30′ is nearly identical to the operating handle attachment 30 of Figure 2, including a stamped metallic member 40′ having a handle-engaging segment 32′ including opposing handle-receiving apertures 42′, 43′ and an interfacing segment 34′ including a tab 36′ with an opening 38′. However, as shown, both of the handle-receiving apertures 42′, 43′ include a plurality of serrations 44′ (*e.g.*, teeth), structured to securely engage the operating handle 18 (Figure 1).

As shown in Figure 4, another operating handle attachment 130 includes a handle-engagement segment 132 consisting of a clamping segment 142 having opposing sides 148, 150 and two spaced-apart fasteners, such as the exemplary screws 146. The interfacing segment 134 consists of a tab 136 on opposing side 150, which includes an opening 138 for receiving the connector 24 (Figure 1) similar to the manner in which the operating handle attachment 30 of Figure 1 receives such connector. The exemplary operating handle attachment 130 is a metallic member 140 including at least one projection, such as the plurality of serrations 144, shown, on at least one of the opposing sides 148, 150 (the serrations 144 are shown on opposing side 150 in Figure 4).

Figure 5 illustrates an operating handle attachment 130′ substantially similar to the operating handle attachment 130 of Figure 4. The exemplary metallic member 140′ includes a handle-engaging segment 132′ consisting of a clamping segment 142′ with opposing sides 148′, 150′. The interfacing segment 134′ consists of a tab 136′ having an opening 138′ for receiving the connector 24 (Figure 1). Two locking mechanisms or fasteners, such as the exemplary screws 146, extend between the opposing sides 148′, 150′, in order to compress the opposing sides 148′, 150′ against the circuit breaker operating handle 18 (Figure 1) when the top of such operating handle is inserted into the clamping segment 142′ between the exemplary screws 146 and such screws are tightened. However, in this embodiment, the at least one projection includes a single projection 144′ on each of the opposing sides 148′, 150′, structured to further secure the circuit breaker operating handle 18 (Figure 1) when the exemplary screws 146 are tightened.

Figure 6 shows another operating handle attachment 130'' consisting of a metallic member 140'' formed to include a handle-engaging segment 132'' having a clamping segment 142'' with opposing sides 148'', 150'' and a fastener, such as the exemplary screw 146, in order to compress the opposing sides 148'', 150'' together when tightened. The interfacing segment 134'' consists of a tab 136'', which is part of opposing side 150'' and which includes an opening 138'' to receive the connector 24 (Figure 1). The exemplary embodiment of the operating handle attachment 130'' includes a single projection 144'' on each of the opposing sides 148'', 150''.

The operating handle attachments 130, 130', 130'' of Figures 4-6 may be machined or formed from a material, such as, for example, metal. However, it will be appreciated that such operating handle attachments may be made from processes other than machining, such as, for example, forming or casting. Additionally, the attachments may employ a variety of suitable alternative shapes and sizes (not shown), and may be made from a wide variety of suitable materials (not shown).

For example, Figure 7 shows an operating handle attachment 230 in which the handle-engaging segment 232 includes a molded member 240, molded from a material such as, for example, plastic. The molded member 240 includes a handle-receiving aperture 242 for receiving the end of the circuit breaker operating handle 18 (Figure 1). An opening 244 in the molded member 240 receives a threaded fastener, such as the exemplary set screw 246, in order to engage the operating handle 18 when the set screw 246 is tightened. The interfacing segment 234 consists of an opening 238 formed in the molded member 240, as shown, to receive the connector 24 (Figure 1).

Figure 8 illustrates the operating handle attachment 30 of Figures 1 and 2, as employed on the operating handle 18 of the single-pole circuit breaker 12. In operation, the exemplary stamped metallic member 40 slides over the top of the circuit breaker operating handle 18, in order that such handle fits through the opposing handle-receiving apertures 42, 43 and is securely engaged by the serrations 44. The second portion 28 of the exemplary connector 24 (shown in phantom-line drawing) is then inserted through the opening 38 in the tab 36 of the interfacing segment 34. The first portion 26 of the connector 24 is then interfaced or linked with

another switching apparatus, such as the exemplary actuating handle 20 (Figure 1) to permit remote operation of the circuit breaker operating handle 18.

Figure 9 shows the operating handle attachment 130′ of Figure 5 as employed on the operating handle 18 of the single-pole circuit breaker 12. In this embodiment, the operating handle 18 fits within the clamping segment 142′ of the handle-engaging segment 132′, as shown. The exemplary screws 146, on either side of the operating handle 18, are then tightened to compress the opposing sides 148′, 150′, against the operating handle 18 to secure it therein. The projection 144′ on each of the opposing sides 148′, 150′ operates to further secure the operating handle 18.

As shown in Figure 10, the operating handle attachment 130′′ of Figure 6 is employed in much the same manner as described above with respect to Figure 9. As shown, the metallic member 140′′ forms a generally U-shaped handle-engaging segment 132′′ including a clamping segment 142′′ with opposing sides 148′′, 150′′ structured to receive the operating handle 18 therebetween. The single screw 146, adjacent the operating handle 18, compresses the opposing sides 148′′, 150′′ against the operating handle 18 when tightened. The single projection 144′′ on each of the opposing sides 148′′, 150′′ functions to further secure the operating handle 18. In this manner, the connector 24 (Figure 1) may be inserted through the opening 138′′ in the tab 136′′ on opposing side 150′′ to facilitate actuation of the operating handle 18 from a remote location, for example, the external panel 8 (Figures 1 and 11) of the switchgear cabinet 4 (Figures 1 and 11).

It will be appreciated that the operating handle attachments of Figures 8-10 could be disposed in any number of suitable alternative orientations (not shown) on the circuit breaker operating handle 18. It will also be appreciated that any suitable variation (not shown) or count (not shown) of operating handle attachment components, for example, tab 36, opening 38 or fastener 146, may be employed.

Figure 11 illustrates the exemplary assembled power distribution system 2 and electrical switching apparatus interface assembly 10. As shown, the circuit breaker 12 is disposed within the interior 6 of the switchgear cabinet 4. The operating handle attachment 30 is securely engaging the circuit breaker operating handle 18. The tab 36 receives the second portion 28 of the connector 24. The connector tab 22 on the underside of the exemplary actuating handle 20 extends

downwardly through the external panel 8 of the switchgear cabinet 40, to receive the first portion 26 of connector 24, as shown. In this manner, the circuit breaker 12 located within the interior 6 of the switchgear cabinet 4 may be actuated from the external, remote location on the external panel 8. As shown, the circuit breaker operating handle 18 has first and second "on" and "off" positions. The exemplary actuating handle 20 is likewise operable between two positions corresponding to the "on" and "off" positions of the circuit breaker 12. Accordingly, for example, when the actuating handle 20 is pivoted from the "off" position to the "on" position, the exemplary steel rod connector 24 interfaces or transmits such movement to the operating handle attachment 30, thereby moving the circuit breaker operating handle 18 to the "on" position, in order to energize the power distribution system 2.

It will be appreciated that any count of suitable connectors (not shown) other than the exemplary steel rod connector 24 and having a wide array of different orientations (not shown), may alternatively be employed. For example, a flexible cable connector (not shown) could alternatively be used to interface or link the electrical switching apparatus. It will also be appreciated that the interface assembly 10 may be employed with a wide variety of electrical switching apparatus (not shown), other than the exemplary single-pole circuit breaker 12 (*e.g.*, without limitation, multi-pole circuit breakers).

Accordingly, the present invention provides a simplified interface as contrasted with the known prior art by eliminating unnecessary, cumbersome parts and replacing complex designs with one that can be readily employed with a variety of switches without requiring modification to the switch handle or electrical switching apparatus housing.

While specific embodiments of the invention have been described in detail, it will be appreciated by those skilled in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of invention which is to be given the full breadth of the claims appended and any and all equivalents thereof.